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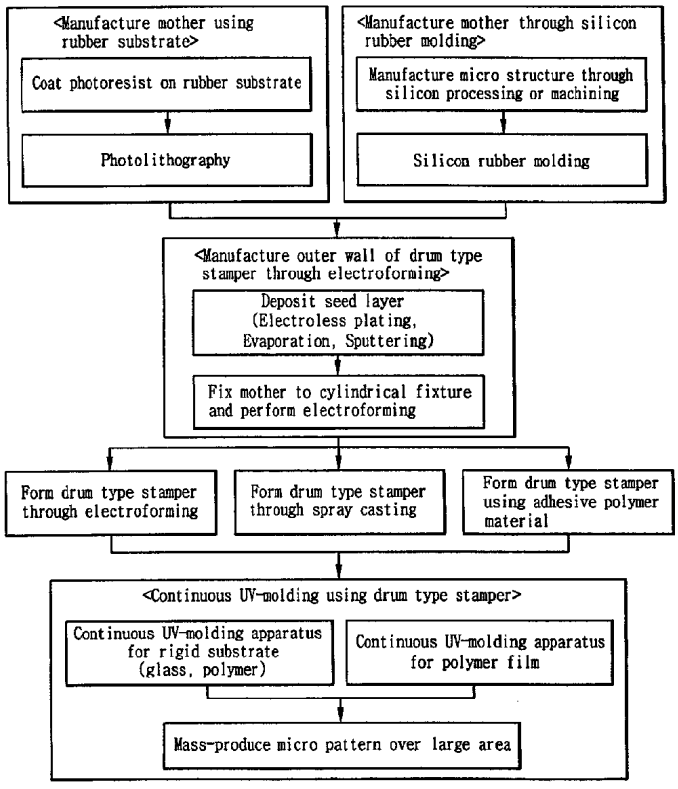

(57) Abstract: A method of fabricating a drum type stamper (13) for continuously forming a micro pattern structure including a large-area micro pattern structure includes the steps of manufacturing a mother for the drum type stamper (13); fixing the mother to an inner peripheral surface of a cylindrical fixture (10); and manufacturing the drum type stamper (13) by performing electroforming on an inner peripheral surface of the mother. Further, an apparatus for continuously forming a micro pattern structure including a large-area micro pattern structure includes a drum type stamper (13); a conveying means for conveying a substrate such that the substrate faces the drum type stamper (13); a supplying means for supplying a photopolymer between the drum type stamper (13) and the substrate; and an irradiating means for irradiating ultraviolet rays onto the photopolymer stamped by the drum type stamper (13).

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APPARATUS AND METHOD FOR CONTINUOUSLY FORMING THE MICRO PATTERN STRUCTURE AND METHOD FOR FABRICATING A DRUM-TYPE STAMPER USED IN THE SAME

Technical Field

The present invention relates to an apparatus and method for forming a micro pattern structure, and more particularly, to an apparatus and method for continuously forming a micro pattern structure over large area, and a method for fabricating a drum type stamper used therein.

Background Art

Recently, as sizes of displays increase, sizes of parts for displays, such as light guide plates and display panels, on which micro patterns have to be formed increase accordingly.

At present, micro pattern parts for large size displays are mainly manufactured by means of a glass etching method. However, such a method has many problems in view of manufacturing costs and precision of micro patterns.

According to an UV-molding method, a polymer micro pattern can be formed on a glass substrate. Thus, this method can be applied to processes of manufacturing parts for large size displays that require micro patterns on glass substrates.

The UV-molding method is a process using photopolymers that react to ultraviolet rays and form chain structures. Since this method can be performed under room temperature and low pressure, the method has advantages in that it is very suitable for forming ultramicro patterns, and products manufactured by the method have thermal stability and optical properties superior to those by other methods. Further, as described above, the UV-molding method has an advantage in that it enables micro patterns to be formed on glass substrates or electronic

devices for information technology as well as simple polymer products.

The conventional UV-molding method uses a planar stamper made of silicon or metal. In the method, after a viscous photopolymer is coated onto a substrate, a stamper with a micro pattern formed thereon is pressed onto the coated substrate. At this time, ultraviolet rays are irradiated thereon to cure the photopolymer.

Accordingly, when the UV-molding method is employed in forming parts for large size displays, stamper, exposing apparatus and other additional apparatuses of large size are required. Further, it is very difficult to keep thickness uniformity over a large area, which results in increase in costs for manufacturing molds and equipment expenses. Thus, it is difficult to attain reduction in a unit cost of a product which is an advantage of a molding method. That is, as compared with other methods, the conventional UV-molding method exhibits considerably superior productivity in forming micro patterns over small area, for example, forming micro optical elements on a silicon wafer. However, the method is difficult to be applied to parts with micro patterns over large area, such as display parts, riblet films and projection screens, for which there is a great demand recently.

Further, since a production cycle of such a conventional discontinuous UV-molding is relatively longer than that of a continuous forming method, there is a fatal defect in view of mass production.

In the meantime, large size parts with micro patterns can be manufactured by means of a hot embossing method using a roller. In this case, since only parts made of a single material, plastic, can be manufactured, there is a problem in that when the method is applied to manufacture of displays or the like, a complicated process in which a micro pattern manufactured in the form of a film has to be adhered to a glass substrate is required instead of direct stamping of a micro pattern on the glass substrate.

As described above, heretofore, all micro pattern structures have been

manufactured at a small amount and at a high price by means of expensive equipment. Particularly, in connection with a large-area micro pattern structure, there is no manufacturing method with high productivity and mass productivity.

Disclosure of Invention

Accordingly, an object of the invention is to provide a novel micro pattern forming method by which a micro pattern can be continuously formed over large area.

Another object of the present invention is to provide a novel micro pattern forming method by which a high-quality micro pattern structure can be continuously formed over large area on a substrate, more particularly, on a glass substrate.

A further object of the present invention is to provide a micro pattern forming method that can be usefully applied to manufacture of a flat panel display, by which a large-area micro pattern can be formed with high precision on a glass substrate having high thermal stability.

A still further object of the present invention is to provide a stamper suitable for continuously manufacturing a micro pattern structure.

In the process of forming a micro pattern structure as described above, it is preferable to use an UV-molding method and apply a drum type stamper to forming the micro pattern structure. This enables a high-quality micro pattern structure to be formed on a glass substrate or a plastic film substrate over large area. Particularly, since such a process of forming the micro pattern structure can form a micro pattern with high precision over large area on the glass substrate having high thermal stability, it can be usefully applied to manufacturing the flat panel display. Further, if an adhesive film with a micro pattern formed thereon is used, it is possible to manufacture a product which has a micro pattern formed on an opaque substrate over large area.

Preferably, a continuous UV-molding is used as a method of continuously

forming a micro pattern structure according to the present invention. To implement the continuous UV-molding method, a cylindrical stamper is manufactured and applied to the method.

According to the present invention for achieving these objects, there is provided a method of fabricating a drum type stamper for continuously forming a micro pattern structure including a large-area micro pattern structure, including the steps of manufacturing a mother for the drum type stamper; fixing the mother to an inner peripheral surface of a cylindrical fixture; and manufacturing the drum type stamper by performing electroforming on an inner peripheral surface of the mother.

Preferably, only an outer wall of the drum type stamper is formed by the electroforming, and an inner space surrounded by the outer wall is formed by an additional filling process.

Preferably, the additional filling process is performed through any one of electroforming, spray forming and adhesive polymer filling.

Preferably, the mother is manufactured by forming a photoresist micro pattern on a rubber type substrate using photolithography or holographic lithography.

Preferably, the mother is manufactured by manufacturing a master with the micro pattern, and molding silicon rubber using the master.

According to the present invention, there is provided an apparatus for continuously forming a micro pattern structure including a large-area micro pattern structure, including a drum type stamper; a conveying means for conveying a substrate so that the substrate faces the drum type stamper; a supplying means for supplying a photopolymer between the drum type stamper and the substrate; and an irradiating means for irradiating ultraviolet rays on the photopolymer stamped by the drum type stamper.

Preferably, the micro pattern structure is a part for a flat panel display, a projection screen or a riblet structure.

Preferably, the substrate is a glass type substrate.

Preferably, the supplying means supplies the photopolymer onto a surface of one of the drum type stamper and the substrate which face each other.

Preferably, the conveying means comprises at least two rollers installed on a side opposite to the drum type stamper with respect to the substrate, and the two rollers are installed upstream and downstream of the drum type stamper, respectively, the drum type stamper crossing a line connecting the two rollers such that a contact area of the substrate to be in contact with an outer periphery of the drum type stamper can be enlarged.

According to the present invention, there is provided a method of continuously forming a micro pattern structure including a large-area micro pattern structure, wherein a photopolymer is supplied to come into contact with an outer periphery of a drum type stamper, the photopolymer is stamped through the contact with the drum type stamper and ultraviolet rays are irradiated onto the stamped photopolymer to cure the stamped photopolymer, thereby a micro pattern on the outer periphery of the drum type stamper being transferred to the photopolymer to form continuously a structure with the micro pattern.

As described above, the method of forming a micro pattern structure according to the present invention is based on the continuous UV-molding method. As for the continuous UV-molding method, there are a method of continuously forming a micro pattern on a material with high rigidity such as glass and a method of continuously forming a micro pattern on a material with high flexibility such as a polymer film, according to properties of an end product.

The continuous UV-molding method of forming a micro pattern structure roughly needs three (3) steps of manufacturing a mother to be used in manufacturing the drum type stamper, manufacturing the drum type stamper, and manufacturing a continuous UV-molding apparatus using the drum type stamper.

As for methods of fabricating drum type stampers, there are a method in

which a mother is manufactured out of flexible rubber material, fixed to a cylindrical fixture and then subjected to electroforming or the like, a method in which a metal sheet is manufactured and attached to an outer wall of a drum type structure to manufacture a drum type stamper, and a method in which a drum-shaped structure is directly machined to manufacture a drum type stamper.

Brief Description of Drawings

FIG. 1 is a block diagram showing procedures of mass-producing a micro pattern structure over large area in which a continuous UV-molding process is conducted using a drum type stamper manufactured by using a flexible rubber type mother;

FIG. 2 is a block diagram showing procedures of mass-producing a micro pattern structure over large area in which a continuous UV-molding process is conducted using a drum type stamper manufactured by adhering a metal sheet with a micro pattern formed thereon to the surface of a drum-shaped structure;

FIG. 3 is a block diagram showing procedures of mass-producing a micro pattern structure over large area in which a continuous UV-molding process is conducted using a drum type stamper directly manufactured by means of conventional machining;

FIG. 4 schematically shows a process of manufacturing a mother with a micro pattern by coating a photoresist on a rubber substrate and then patterning the photoresist;

FIG. 5 schematically shows a process of manufacturing a mother with a micro pattern by molding silicon rubber;

FIG. 6 schematically shows a process of forming an outer wall of a drum type stamper with a predetermined thickness by adhering a flexible rubber type mother to a cylindrical fixture and then conducting electroforming;

FIG. 7 schematically shows a process of continuing the electroforming

inside the outer wall of the drum type stamper manufactured in FIG. 6, to fabricate the drum type stamper;

FIG. 8 schematically shows a process of conducting spray forming inside the outer wall of the drum type stamper manufactured in FIG. 6, to fabricate the drum type stamper;

FIG. 9 schematically shows a process of filling an adhesive polymer inside the outer wall of the drum type stamper manufactured in FIG. 6, to fabricate the drum type stamper;

FIG. 10 schematically shows a process of fabricating a drum type stamper in which a metal sheet is electroformed on a silicon mother with a micro pattern formed thereon and then adhered to a drum-shaped structure;

FIG. 11 schematically shows an apparatus for continuously forming a micro pattern over large area on a substrate with high rigidity using a continuous UV-molding method;

FIG. 12 schematically shows an apparatus for continuously forming a micro pattern over large area on a flexible film type substrate using a continuous UV-molding method; and

FIG. 13 is a schematic view illustrating a process in which an end product is manufactured by adhering an adhesive film with a micro pattern formed thereon by means of a continuous UV-molding method to an opaque substrate or a glass substrate.

Best Mode for Carrying Out the Invention

Hereinafter, the constitution and effects of the invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a block diagram showing procedures of manufacturing a micro pattern structure in which a continuous UV-molding process is conducted using a drum type stamper manufactured by using a flexible rubber type mother.

The figure shows that a UV-molding process continuously forms a micro pattern on a material with high rigidity such as glass using a stamper manufactured by using a flexible mother or on a material with high flexibility such as a polymer film using the stamper, according to the properties of end products.

Here, the flexible rubber type mother is manufactured by coating a photoresist on a rubber substrate and patterning the photoresist through photolithography or holographic lithography, or by molding a silicon rubber material using a master manufactured through machining or silicon processing.

In order to fabricate a drum type stamper, a seed layer for electroforming is deposited on the manufactured rubber type mother, and then the mother is adhered to a cylindrical structure and subjected to electroforming. After the electroforming is performed to a certain degree and an outer wall of a drum type stamper is formed, a process such as electroforming, spray forming or adhesive polymer filling is performed to complete a drum type stamper. The end stamper can be applied to both the continuous UV-molding apparatus for the rigid substrate and the continuous UV-molding apparatus for the film substrate. It is possible to mass-produce a micro pattern structure over large area by means of any one of the above methods.

FIG. 2 is a block diagram showing procedures of manufacturing a micro pattern structure in which a continuous UV-molding process is conducted using a drum type stamper manufactured by adhering a metal sheet to a drum-shaped structure. The metal sheet is manufactured by depositing a seed layer on a silicon mother with a micro pattern formed thereon through a variety of semiconductor processes including photolithography and etching, and then performing the electroforming on the silicon mother with the seed layer deposited thereon. Thereafter, the manufactured metal sheet is adhered to the surface of the drum-shaped structure to complete a drum type stamper. Then, the continuous UV-molding process is performed using the stamper.

FIG. 3 is a block diagram showing procedures of manufacturing a micro

pattern structure in which a continuous UV-molding process is conducted using a drum type stamper manufactured by means of machining.

It is possible to manufacture the drum type stamper by performing precision machining such as diamond –turning directly on a drum-shaped structure with no micro pattern.

FIG. 4 schematically shows a process of manufacturing a flexible rubber type mother by which a pattern of a photoresist 2 is formed on a rubber substrate 1. In this process, the photoresist 2 is coated at a desired thickness on the rubber substrate 1. Here, the thickness of the coated photoresist is determined depending on the viscosity of the photoresist and the rotational speed of a spin coating. Thereafter, the coated photoresist 2 is subjected to photolithography 3 or holographic lithography 4, and a rubber type mother 5 with the same pattern as an end product is then manufactured through a developing process. Although this method can rapidly and uniformly form a pattern such as a simple lattice texture over large area, it has a disadvantage in that a variety of patterns cannot be formed.

FIG. 5 is a schematic view illustrating a process of manufacturing a rubber type mother 5 through silicon rubber molding. First, a master 6 whose pattern is counter to a pattern of an end product is manufactured. A pattern of the master 6 can be fabricated on a silicon wafer or a metal material through semiconductor processes including conventional photolithography and etching, or precision machining. Thereafter, a silicon rubber material 7 such as polydimethysiloxane (PDMS) is molded using the manufactured master 6 to finally manufacture the flexible rubber type mother 5. Since this method is the process of forming a pattern on a silicon or metal material through conventional silicon processing or precision machining and transferring the pattern on a silicon rubber material to manufacture a mother, there is a disadvantage in view of manufacturing costs and time. However, there is an advantage in that a variety of patterns can be formed.

FIG. 6 is a schematic view illustrating the process of forming an outer wall of

a drum type stamper using the flexible rubber type mother 5 manufactured by means of the aforementioned method. First, forming a seed layer 8 on the rubber type mother 5 is conducted as pre-processing for electroforming. Here, the seed layer 8 is deposited as a thin film through electroless plating, sputtering or evaporation. If a mother made of a material such as PDMS is used, its surface energy is low and thus the adhesiveness of the seed layer thereto may be bad. Therefore, pre-processing such as corona discharge may be conducted to increase the adhesiveness to the surface (PDMS). Even if mothers made of other materials is used, pre-processing for improving the adhesiveness may be performed. Thereafter, a rubber type mother 9 on which the seed layer is deposited by means of the above process is rolled and fixed to an inner surface of a hollow cylindrical fixture 10 such that the micro pattern of the mother 9 faces inward. Thereafter, the electroforming is performed, and thereby a metal layer 11 grows from the seed layer. After a predetermined period of time, an outer wall of a drum type stamper with predetermined thickness is obtained. Although a variety of alloy materials can be used as a material for electroforming, nickel is mainly used.

An inner body inside the outer wall of the drum type stamper is manufactured by means of each of the following three (3) processes or a combination thereof.

FIG. 7 is a schematic view illustrating a process of continuing the electroforming to fabricate the drum type stamper. A supporting shaft structure 12 is installed at the center of the cylindrical fixture 10 to support the drum type stamper. It is considered that this process is most ideal since the entire body of the drum type stamper is manufactured out of the same metal layer 11 through the electroforming. Compared with other methods, however, since a growth rate of the metal layer 11 formed through the electroforming is very slow, there is a disadvantage in that time required for manufacturing the stamper increases.

FIG. 8 is a schematic view illustrating a process in which the supporting

shaft structure 12 for supporting a drum type stamper is located at the center of the cylindrical fixture 10 and a space between the outer wall of the drum type stamper and the supporting shaft structure 12 is filled with a metal layer 14 by means of spray casting. This method allows relatively rapid manufacture of a drum type metal stamper 13.

FIG. 9 is a schematic view illustrating a process in which the space between the outer wall of the stamper and the shaft structure 12 is filled with an adhesive polymer 15. This method allows the drum type stamper 13 to be manufactured at a very high rate.

FIG. 10 is a schematic view illustrating a method of fabricating the drum type stamper 13 using a metal sheet 17. The seed layer 8 is deposited on a silicon mother 16 with a micro pattern formed thereon through semiconductor processes, and then the electroforming is performed on the seed layer to form the metal layer 11.

Then, the metal sheet 17 with a micro pattern is obtained after post-processing for the manufactured metal layer. A conventional mechanical polishing method or a chemical mechanical polishing method can be used as the post-processing. The drum type stamper 13 can be manufactured by evenly adhering the manufactured metal sheet 17 to a drum-shaped structure 18 with no pattern using an adhesive 19. Here, a technique for evenly adhering the metal sheet 17 onto the entire inner surface of the drum-shaped structure is required.

As described above, all the methods of manufacturing the drum type stampers described with reference to FIGS. 7 to 10 employs the process of transferring or bonding the micro pattern formed on the planar substrate to the cylindrical structure.

Accordingly, joining portions of the pattern transferred or bonded to the cylindrical structure may not smoothly be connected. To prevent this problem, optimal values should be given for an initial size of the mother and a diameter of the

drum type stamper depending on the shape and interval of an initial pattern.

To enhance releasability in a following molding process, the manufactured drum type stamper may be additionally subjected to a surface treatment process with a mold release material.

FIG. 11 schematically shows an apparatus for forming a photopolymer micro pattern on a substrate with high rigidity such as glass using any one of the drum type stampers manufactured by means of the aforementioned methods. As shown in the figure, the manufactured drum type stamper 13 is mounted at an upper side, and conveying or supporting small rollers 20 are mounted at a lower side such that a glass or plastic substrate 21 with high rigidity is conveyed over the conveying rollers 20. Before the substrate comes into contact with the drum type stamper, a liquid photopolymer 23 is applied onto the substrate 21 by means of a material supplying means 22.

When the substrate 21 with the photopolymer 23 applied thereon passes below the drum type stamper 13, the micro pattern of the drum type stamper 13 is transferred to the photopolymer 23, and at the same time the photopolymer 23 is exposed to ultraviolet rays irradiated through a bottom surface of the substrate. In the UV-molding method, as soon as a material is exposed to ultraviolet rays, curing is made up to a considerable level. Therefore, in order to prevent the ultraviolet rays from being irradiated onto the photopolymer before it comes into contact with the drum type stamper 13, a blocking mask 25 is installed. The liquid photopolymer 23 begins to be solidified as soon as the photopolymer comes into contact with the drum type stamper 13. After the solidification of the photopolymer is made to a certain degree, the solidified photopolymer is released from the stamper 13 and curing is completed through continuous exposure to the ultraviolet rays 24.

The rollers 20 for conveying and supporting the substrate should be made of transparent material so that the ultraviolet rays can be transmitted therethrough to cure the photopolymer. The resulting substrate is cut to obtain products of desired

shapes through a cutting process.

The ultraviolet continuous forming method shown in Fig. 11 can be applied to not only a rigid substrate such as a glass substrate or a thick plastic substrate but also a film type substrate by mounting a film type substrate on a rigid substrate.

Here, the material may be supplied by applying the material directly to the substrate as shown in FIG. 11 or applying the material on the drum type stamper. Further, it is possible to design an apparatus in which the drum type stamper is installed at the lower side, the substrate is conveyed at the upper side, and the ultraviolet rays are irradiated onto a top surface of the substrate so that a micro pattern can be formed on the bottom surface of the substrate.

In the process described above, the properties of the end product are determined depending on a substrate conveying rate, applied pressure, clearance between the substrate and the drum type stamper, the intensity and the amount of irradiation of the ultraviolet rays, the supply amount of the material, and the like. A micro pattern with superior properties can be continuously formed by controlling the above factors.

FIG. 12 schematically shows an apparatus for forming a photopolymer micro pattern on a flexible film type substrate. In the figure, a film type substrate 27 is in contact with the drum type stamper 13 and conveyed along the outer surface of the stamper 13 by a film-drum contacting roller 28 and a releasing roller 29. A proper amount of the liquid photopolymer 23 is applied onto the drum type stamper 13 through the material supplying means 22, and a photopolymer layer is formed between the film type substrate 27 and the drum type stamper 13 along on a conveying direction of the drum type stamper 13. While it is conveyed along the surface of the drum type stamper 13, a micro pattern of the drum type stamper 13 is transferred to the photopolymer, and at the same time the photopolymer is exposed to the ultraviolet rays 24. Finally, the end product is released from the drum type stamper 13 by the releasing roller 29. This process is very suitable for forming a

micro pattern on a film type substrate. The properties of the end product are determined depending on the supply amount of the material, the intensity and the amount of irradiation of the ultraviolet rays, applied pressure, clearance between the rollers and the drum type stamper, tension applied to the substrate, and the like. A micro pattern with superior properties can be continuously formed by controlling the above factors.

All the two continuous UV-molding methods described above are methods of forming micro patterns on a transparent glass substrate or a transparent polymer substrate. FIG. 13 is a schematic view illustrating a process in which a product having an opaque substrate 35 with a micro pattern formed thereon is manufactured. A photopolymer micro pattern 26 is formed on a transparent adhesive polymer film 34 by means of any one of the above methods, and then the polymer film 34 with the micro pattern formed thereon is adhered to the opaque substrate 35. The transparent adhesive polymer film 34 includes a polymer film layer 31, an adhesive layer 32 and a protection layer 34 for protecting the adhesive layer 32. After the photopolymer micro pattern 26 is formed, the protection layer 33 is removed and the polymer film 34 is then adhered to the opaque substrate 35 to form the micro pattern over large area on the opaque substrate. This method can also be used as a method of adhering the adhesive polymer film 34 with the micro pattern 26 formed thereon to a glass substrate. Further, it is possible that a micro pattern is formed on a general polymer film other than the adhesive polymer film and the polymer film is adhered to an opaque substrate or a glass substrate by means of an adhesive.

According to the present invention described above, it is possible to produce a micro pattern structure over large area in large quantities and at a low price. The continuous UV-molding method using the drum type stamper proposed by the present invention can be the sole method of continuously forming a photopolymer micro pattern on a transparent substrate. According to the present invention, it is possible to continuously form a large-area micro pattern on a substrate. Thus,

parts requiring micro patterns over large area such as parts for flat panel displays, projection screens and riblet structures for reducing drags can be produced at low prices.

Particularly, since a micro pattern structure over large area can be mass-produced in large quantities on a glass substrate with superior thermal stability and optical properties, it is possible to produce parts for large size flat panel displays at low prices.

CLAIMS

1. A method of fabricating a drum type stamper for continuously forming a micro pattern structure including a large-area micro pattern structure, comprising the steps of:

manufacturing a mother for the drum type stamper;

fixing the mother to an inner peripheral surface of a cylindrical fixture; and

manufacturing the drum type stamper by performing electroforming on an inner peripheral surface of the mother.

2. The method as claimed in claim 1, wherein only an outer wall of the drum type stamper is formed by the electroforming, and an inner space surrounded by the outer wall is formed by an additional filling process.

3. The method as claimed in claim 2, wherein the additional filling process is performed through any one of electroforming, spray forming and adhesive polymer filling.

4. The method as claimed in claim 1, wherein the mother is manufactured by forming a photoresist micro pattern on a rubber type substrate using photolithography or holographic lithography.

5. The method as claimed in claim 1, wherein the mother is manufactured by manufacturing a master with a micro pattern, and then molding silicon rubber using the master.

6. An apparatus for continuously forming a micro pattern structure including a large-area micro pattern structure, comprising:

a drum type stamper;

a conveying means for conveying a substrate such that the substrate faces the drum type stamper;

a supplying means for supplying a photopolymer between the drum type stamper and the substrate; and

an irradiating means for irradiating ultraviolet rays on the photopolymer stamped by the drum type stamper.

7. The apparatus as claimed in claim 6, wherein the drum type stamper is manufactured by means of the method of manufacturing the drum type stamper according to any one of claims 1 to 5.

8. The apparatus as claimed in claim 6, wherein the micro pattern structure is a part for a flat panel display, a projection screen or a riblet structure.

9. The apparatus as claimed in claim 6, wherein the substrate is a glass type substrate.

10. The apparatus as claimed in any one of claims 6, 8 and 9, wherein the supplying means supplies the photopolymer onto a surface of one of the drum type stamper and the substrate which face each other.

11. The apparatus as claimed in any one of claims 6, 8 and 9, wherein the conveying means comprises at least two rollers installed on a side opposite to the drum type stamper with respect to the substrate, and the two rollers are installed upstream and downstream of the drum type stamper, respectively, the drum type stamper crossing a line connecting the two rollers so that a contact area of the substrate to be in contact with an outer periphery of the drum type stamper can be

enlarged.

12. A method of continuously forming a micro pattern structure including a large-area micro pattern structure, wherein:

a photopolymer is supplied to come into contact with an outer periphery of a drum type stamper, the photopolymer is stamped through the contact with the drum type stamper and ultraviolet rays are irradiated onto the stamped photopolymer to cure the stamped photopolymer, a micro pattern on the outer periphery of the drum type stamper being transferred to the photopolymer to form continuously the micro pattern structure.

13. The method as claimed in claim 12, further comprising fabricating the drum type stamper according to any one of claims 1 to 6 as a pre-processing.

AMENDED CLAIMS

Received by the International Bureau 08 March 2004 (08.03.04) ;
Original claims 1-5 remain unchanged ; and
Original claims 6-13 replaced by amended claims 6-11.

1. A method of fabricating a drum type stamper for continuously forming a micro pattern structure including a large-area micro pattern structure, comprising the steps of:

manufacturing a mother for the drum type stamper;

fixing the mother to an inner peripheral surface of a cylindrical fixture; and

manufacturing the drum type stamper by performing electroforming on an inner peripheral surface of the mother.

2. The method as claimed in claim 1, wherein only an outer wall of the drum type stamper is formed by the electroforming, and an inner space surrounded by the outer wall is formed by an additional filling process.

3. The method as claimed in claim 2, wherein the additional filling process is performed through any one of electroforming, spray forming and adhesive polymer filling.

4. The method as claimed in claim 1, wherein the mother is manufactured by forming a photoresist micro pattern on a rubber type substrate using photolithography or holographic lithography.

5. The method as claimed in claim 1, wherein the mother is manufactured by manufacturing a master with a micro pattern, and then molding silicon rubber using the master.

6. An apparatus for continuously forming a micro pattern structure including a large-area micro pattern structure, comprising:

the drum type stamper manufactured by the method of manufacturing the drum type stamper according to any one of claims 1 to 5;

a conveying means for conveying a substrate such that the substrate faces the drum type stamper;

a supplying means for supplying a photopolymer between the drum type stamper and the substrate; and

an irradiating means for irradiating ultraviolet rays on the photopolymer stamped by the drum type stamper.

7. The apparatus as claimed in claim 6, wherein the micro pattern structure is a part for a flat panel display, a projection screen or a riblet structure.

8. The apparatus as claimed in claim 6, wherein the substrate is a glass type substrate.

9. The apparatus as claimed in claims 6, wherein the supplying means supplies the photopolymer onto a surface of one of the drum type stamper and the substrate which face each other.

10. The apparatus as claimed in claim 6, wherein the conveying means comprises at least two rollers installed on a side opposite to the drum type stamper with respect to the substrate, and the two rollers are installed upstream and downstream of the drum type stamper, respectively, the drum type stamper crossing a line connecting the two rollers so that a contact area of the substrate to be in contact with an outer periphery of the drum type stamper can be enlarged.

11. A method of continuously forming a micro pattern structure including a large-area micro pattern structure comprising the steps of:

fabricating the drum type stamper by the method of manufacturing the drum type stamper according to any one of claims 1 to 5;

supplying a photopolymer such that the photopolymer comes into contact with an outer periphery of the drum type stamper;

stamping the photopolymer through the contact with the drum type stamper ; and

irradiating ultraviolet rays onto the stamped photopolymer to cure the stamped photopolymer, a micro pattern on the outer periphery of the drum type stamper being transferred to the photopolymer to form continuously the micro pattern structure.

FIG.1

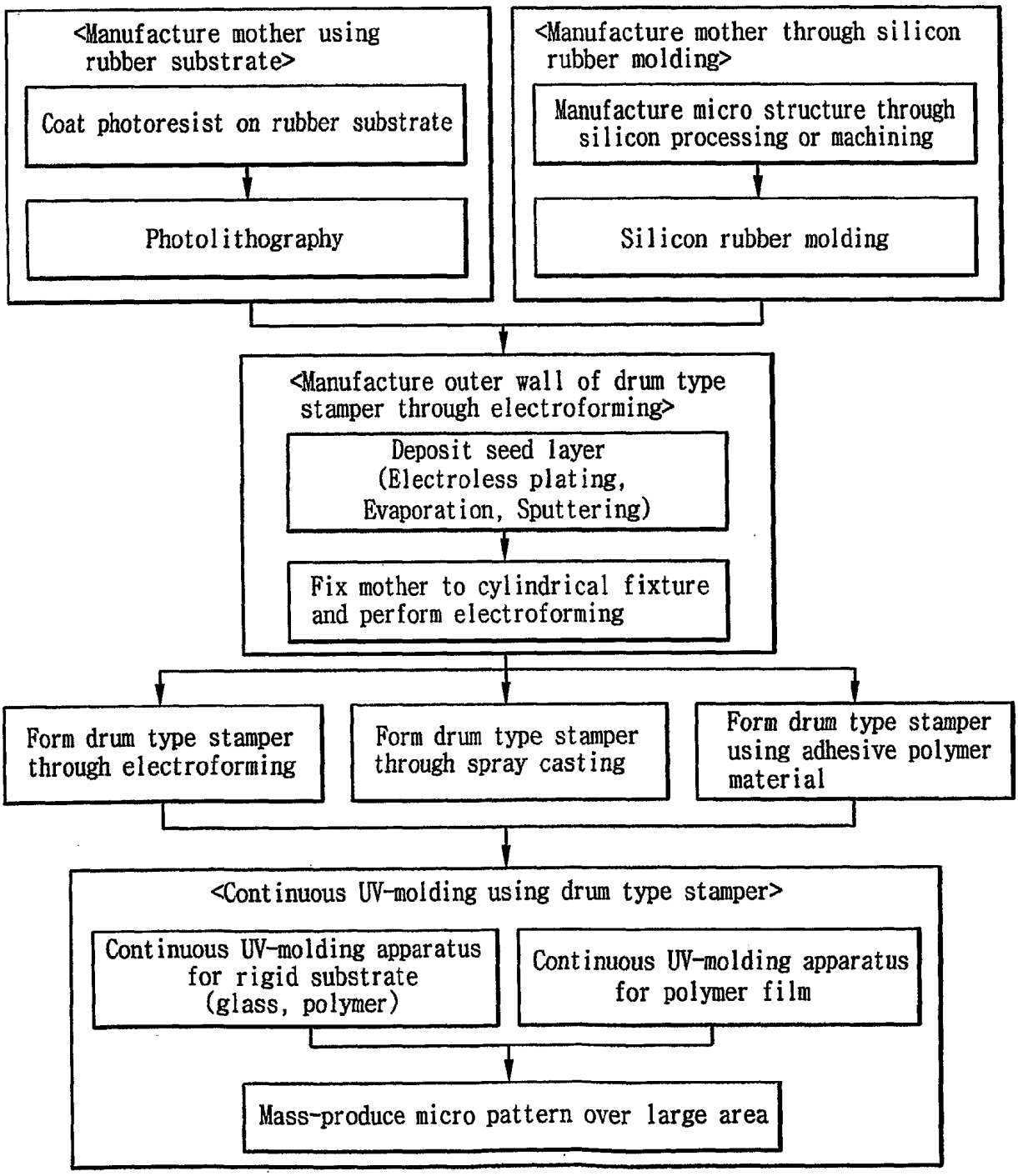

<Manufacture mother using rubber substrate>
Coat photoresist on rubber substrate
Photolithography
<Manufacture mother through silicon rubber molding>
Manufacture micro structure through silicon processing or machining
Silicon rubber molding
<Manufacture outer wall of drum type stamper through electroforming>
Deposit seed layer (Electroless plating, Evaporation, Sputtering)
Fix mother to cylindrical fixture and perform electroforming
Form drum type stamper through electroforming
Form drum type stamper through spray casting
Form drum type stamper using adhesive polymer material
<Continuous UV-molding using drum type stamper>
Continuous UV-molding apparatus for rigid substrate (glass, polymer)
Continuous UV-molding apparatus for polymer film
Mass-produce micro pattern over large area

FIG.2

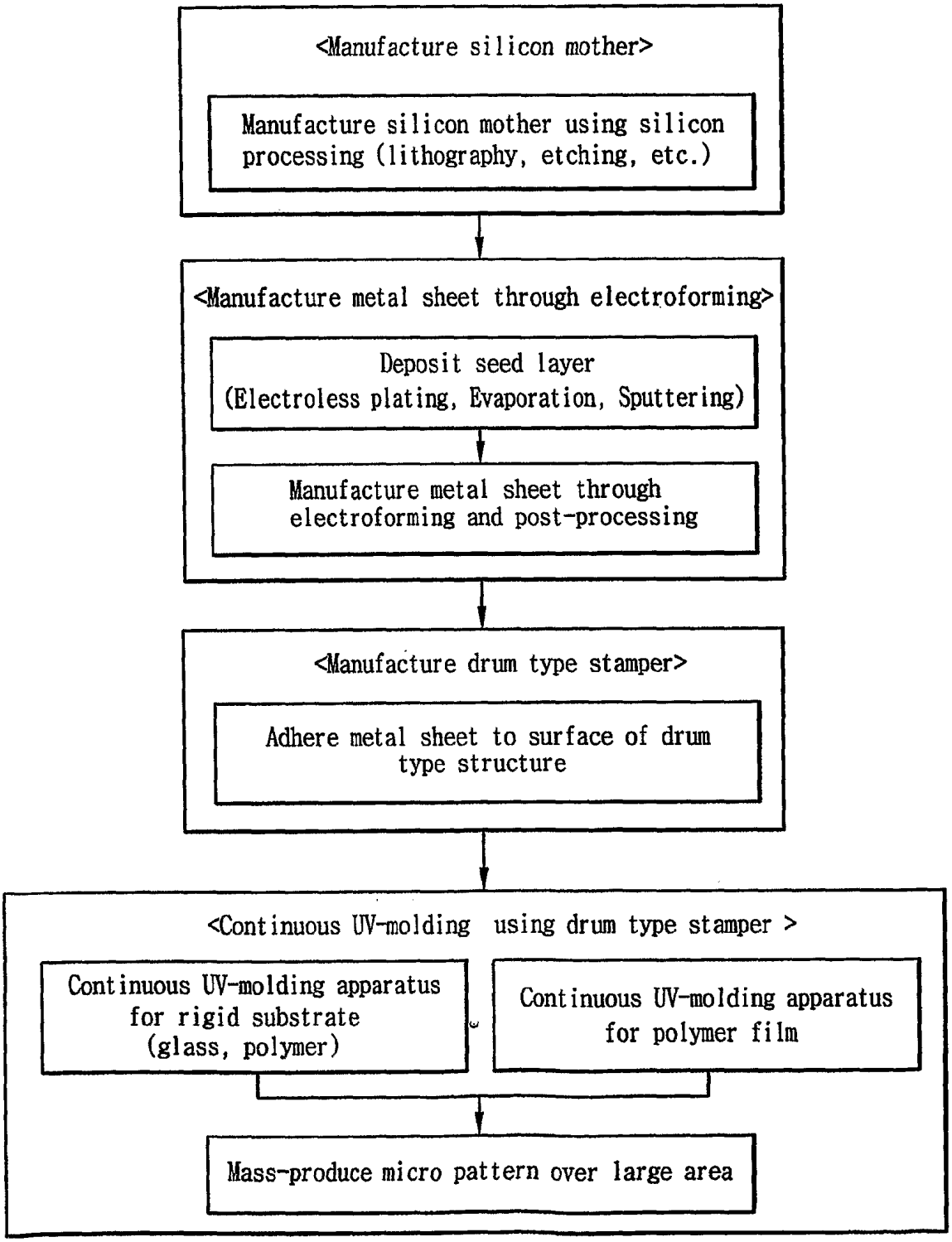

<Manufacture silicon mother>
Manufacture silicon mother using silicon processing (lithography, etching, etc.)
<Manufacture metal sheet through electroforming>
Deposit seed layer (Electroless plating, Evaporation, Sputtering)
Manufacture metal sheet through electroforming and post-processing
<Manufacture drum type stamper>
Adhere metal sheet to surface of drum type structure
<Continuous UV-molding using drum type stamper >
Continuous UV-molding apparatus for rigid substrate (glass, polymer)
Continuous UV-molding apparatus for polymer film
Mass-produce micro pattern over large area

FIG.3

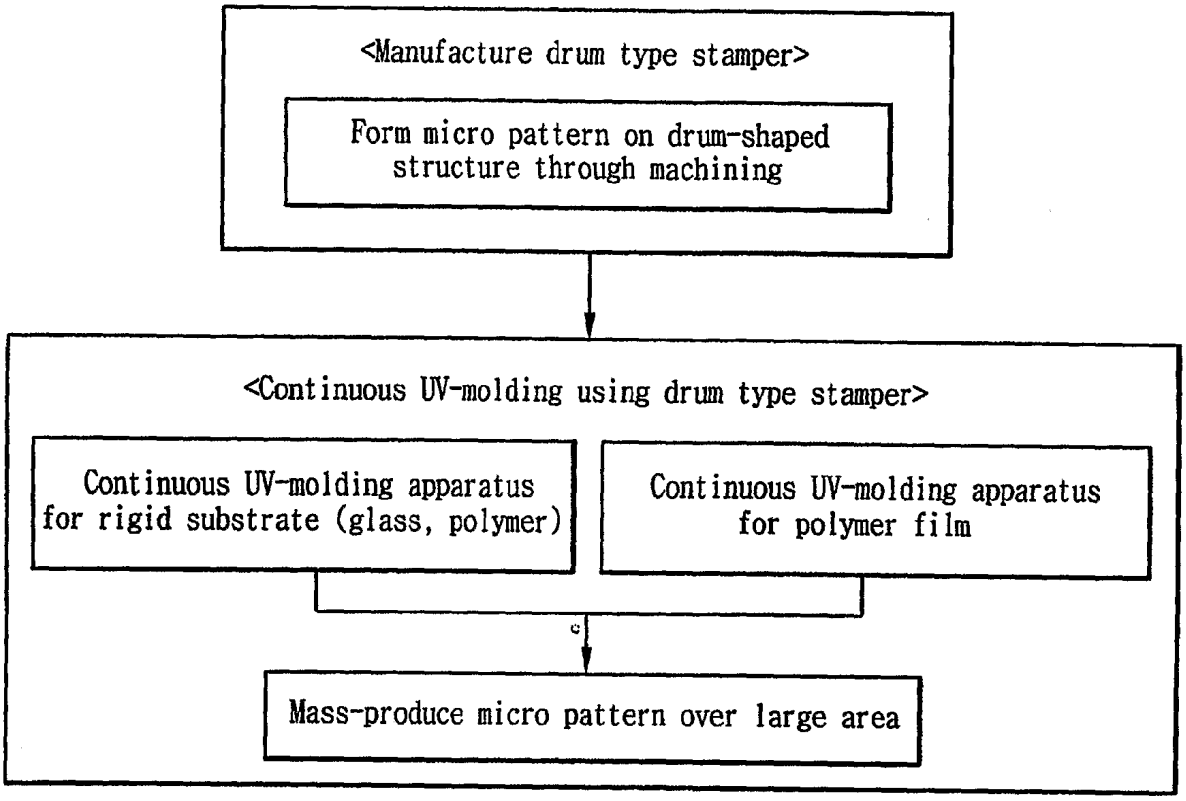

<Manufacture drum type stamper>
Form micro pattern on drum-shaped structure through machining
<Continuous UV-molding using drum type stamper>
Continuous UV-molding apparatus for rigid substrate (glass, polymer)
Continuous UV-molding apparatus for polymer film
Mass-produce micro pattern over large area

FIG.4

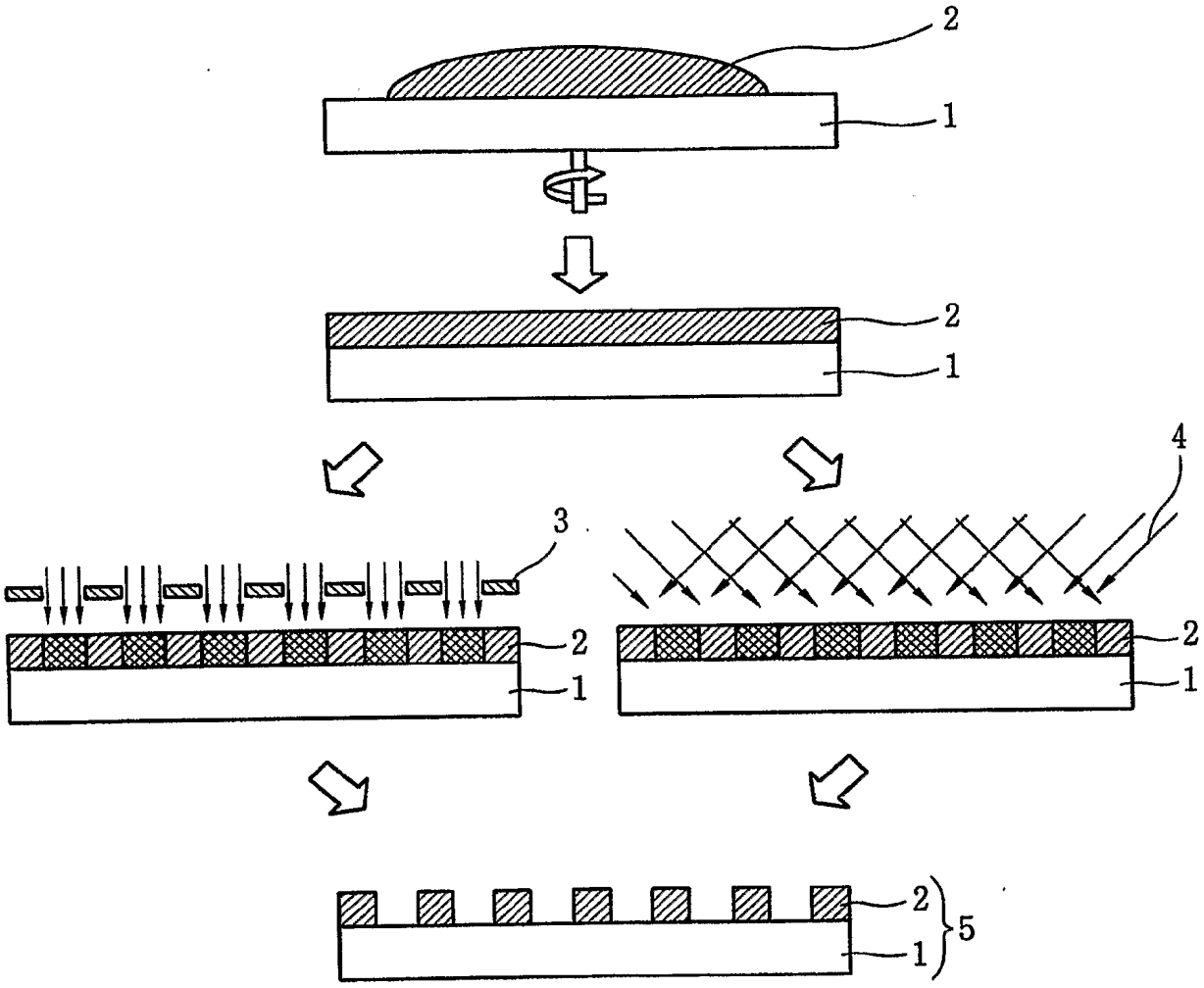


FIG.5

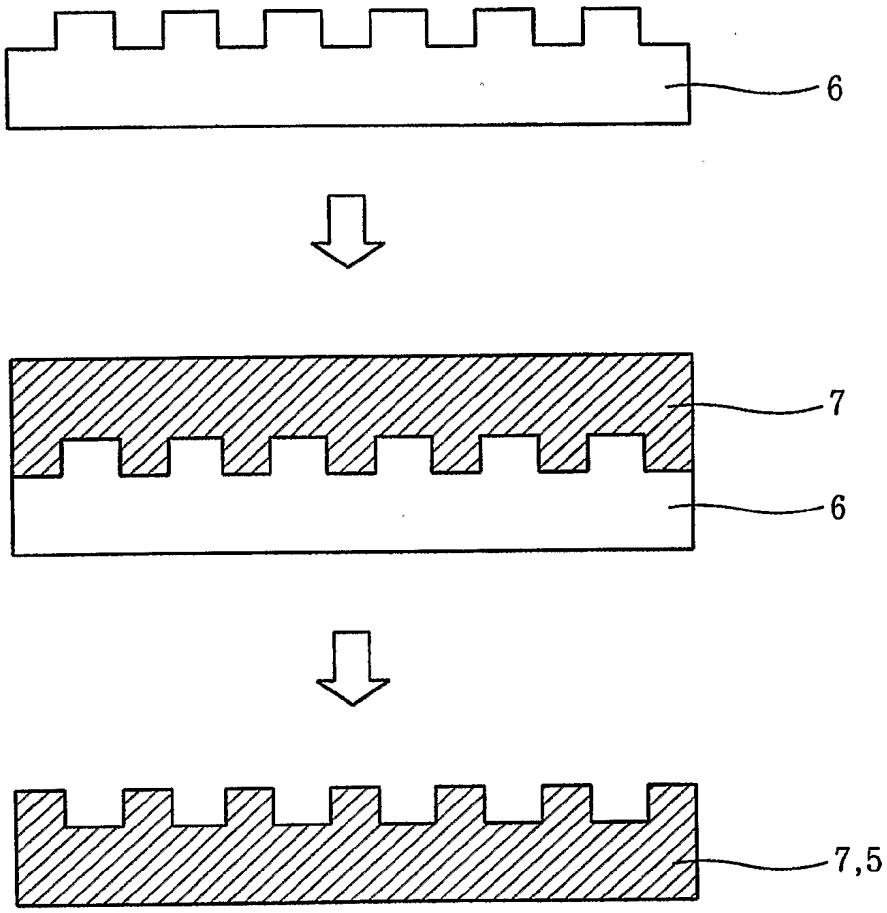


FIG.6

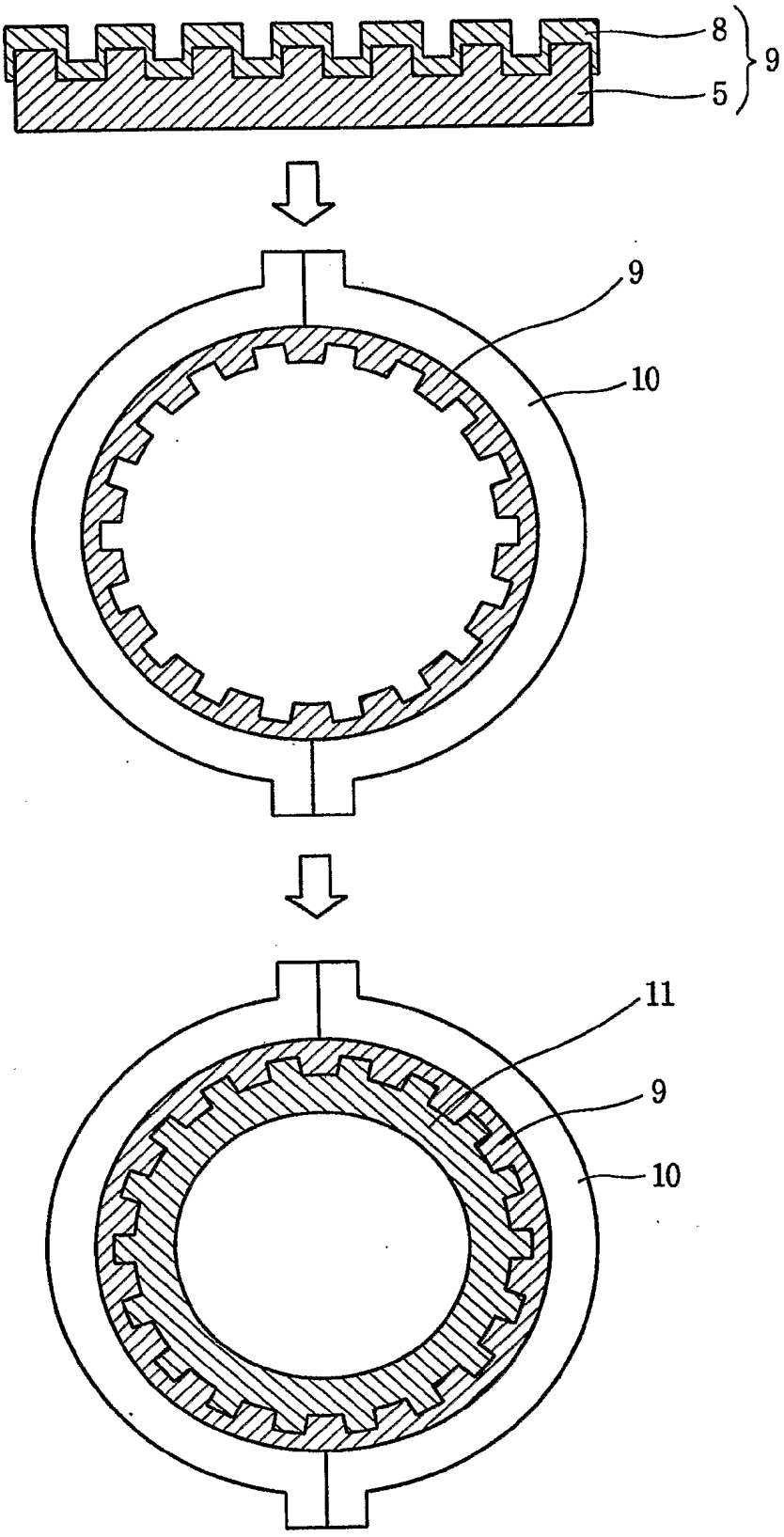


FIG.7

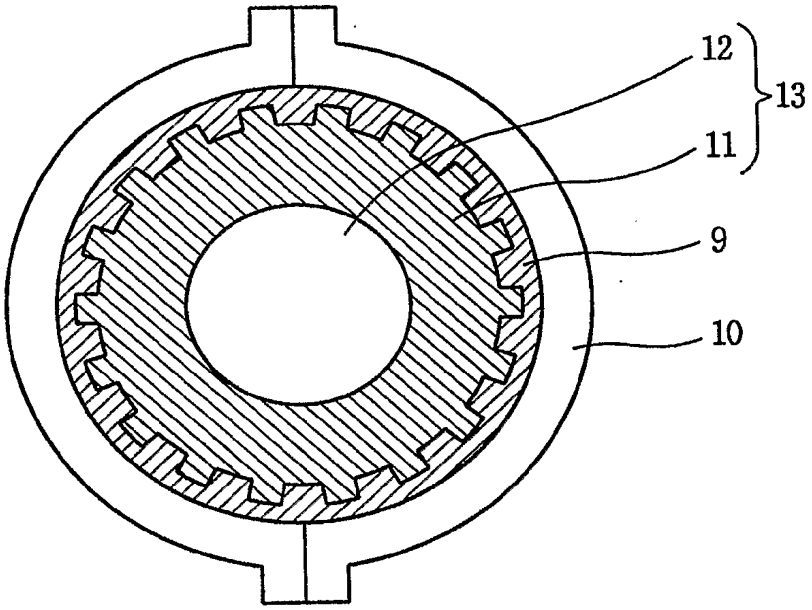


FIG.8

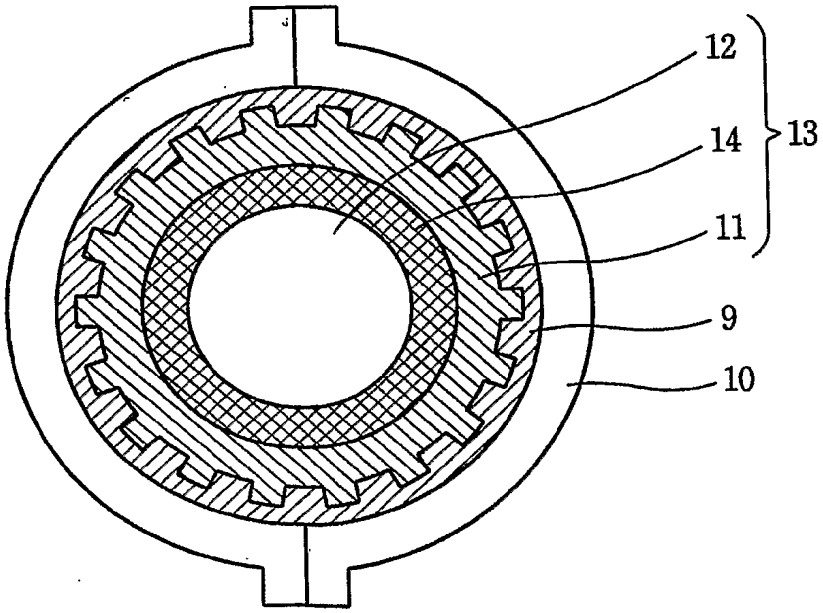


FIG.9

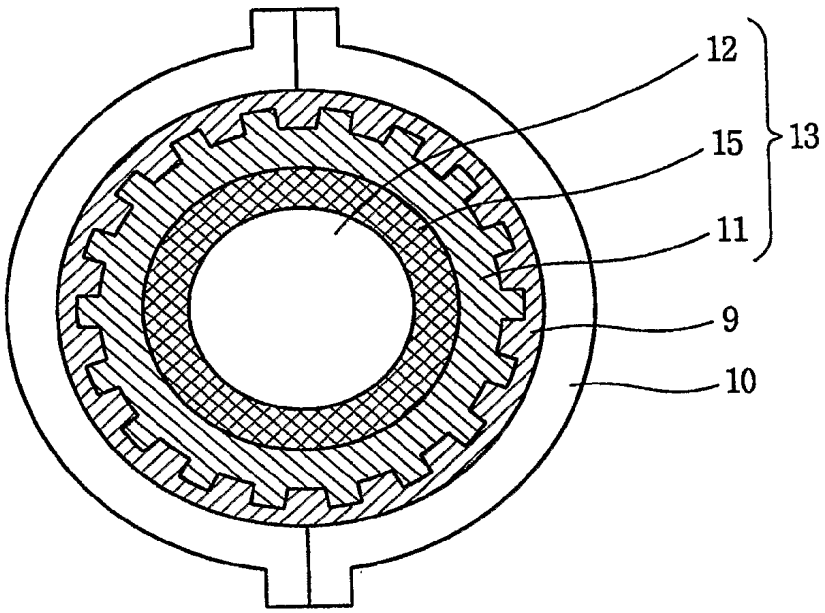


FIG.10

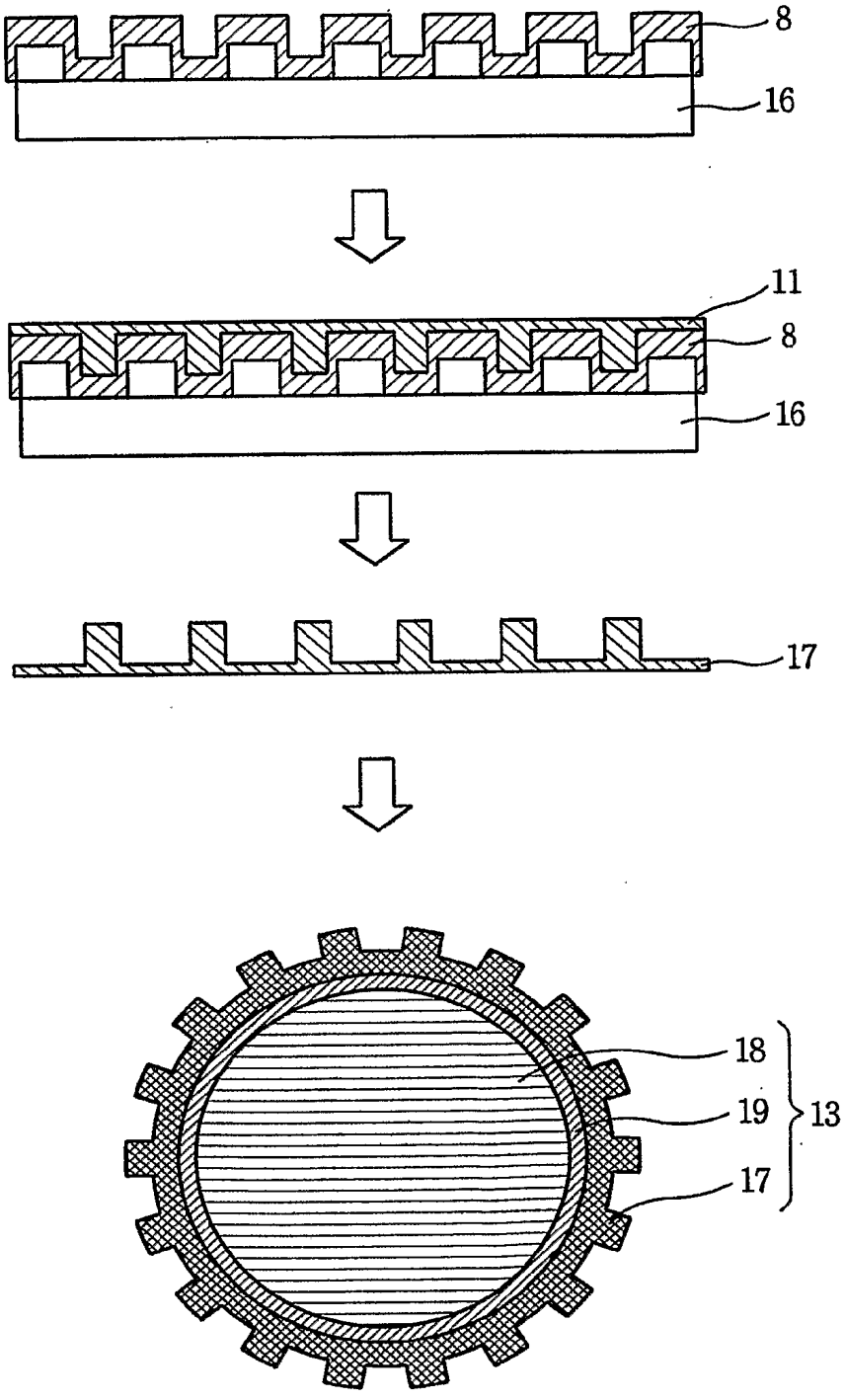


FIG.11

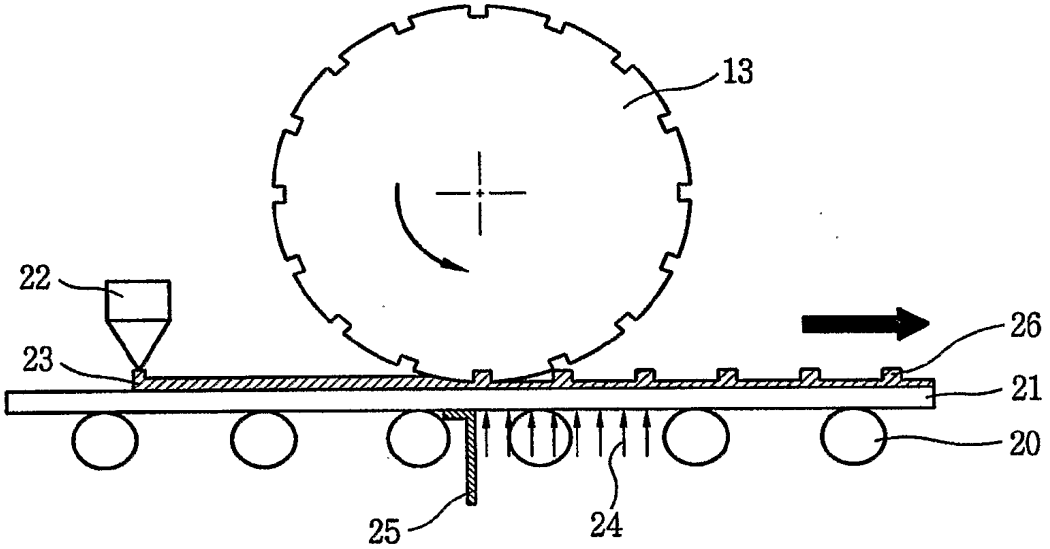


FIG.12

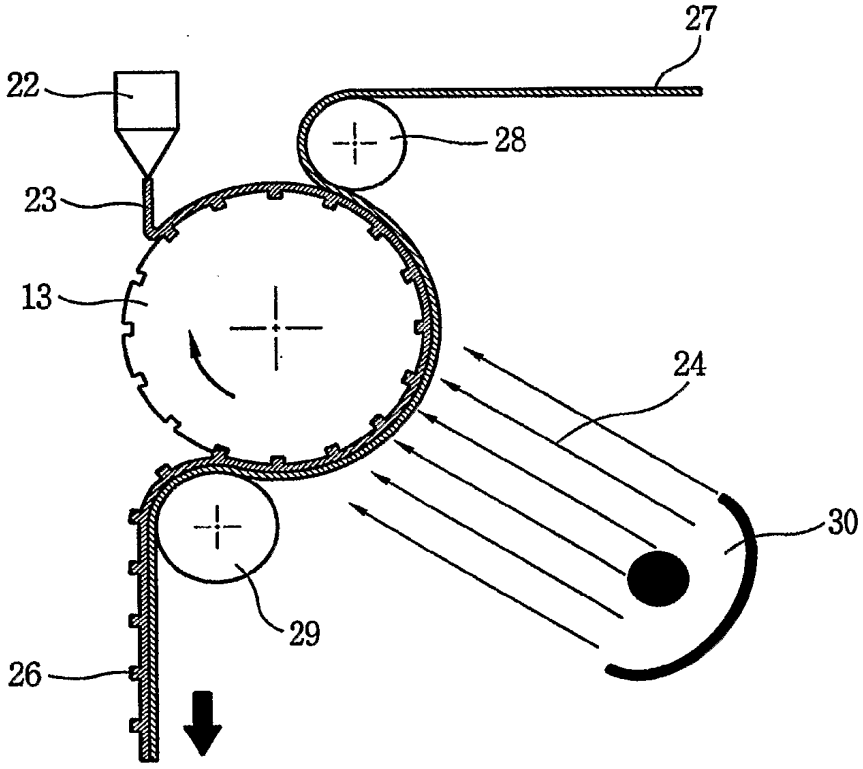
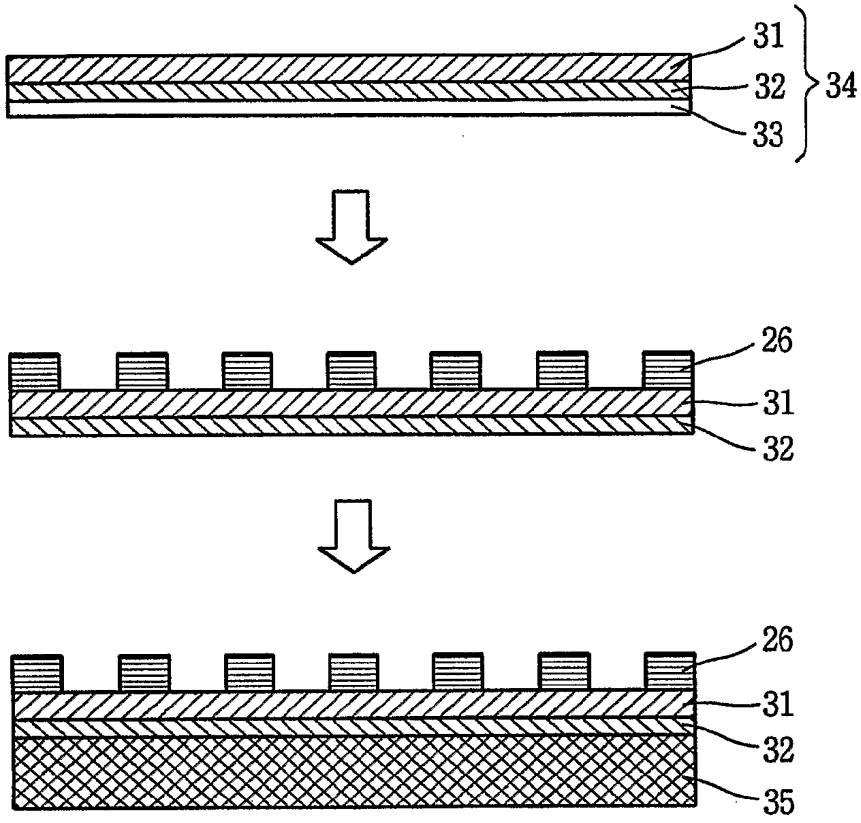


FIG.13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2003/002093

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 B29C 59/04, 41/22, B41K1/02, B41K3/04, B44C1/22, H01L33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 B29C 59/04, 41/22, B41K1/02, B41K3/04, B44C1/22, H01L33/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions, since 1975
Korean Utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CAS on line

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2001-205909 A (IBM) 31. July 2001 (31-07-2001) See the whole document	6, 8-12
Y	KR 10-014974 A (Do, S.U) 28. April 1997 (28-04-1997) See the whole document	6, 8-12
A	WO 01 04938 A (IMRRE/OOSG GMBH&CO.OHG) 8. January 2001 (18-01-2001) See the whole document	8,9
A	US 5900160 A (Whitesides et al.) 04. May 1999 (04-05-1999) See the whole document	6, 8-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
20 JANUARY 2004 (20.01.2004)	20 JANUARY 2004 (20.01.2004)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
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